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"Make No Little Plans"
A.S.M. Headquarters Building
(See article, p. 4)

August, 1960

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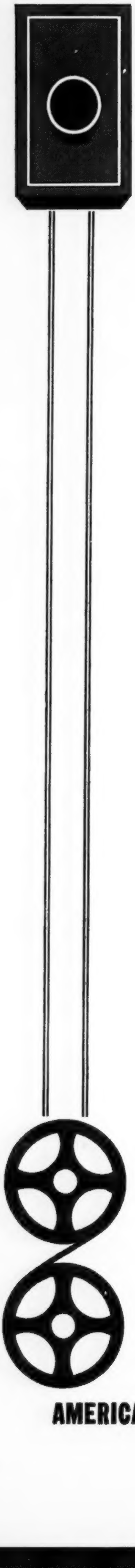
METALS REVIEW

The News Digest Magazine



August, 1960 Vol. XXXIII, No. 8

METALS REVIEW The News Digest Magazine

Contents

Important Lectures

Departments

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"Make No Little Plans"

Formal ceremonies dedicating the new National Headquarters of the American Society for Metals will take place on Wednesday, Sept. 14, 1960, at Metals Park, Novelty, Ohio.

This date was selected by the Society's Board of Trustees to commemorate the founding of the Society 40 years ago, and the important contributions to the growth of the Society by its five late founder members, Theodore E. Barker, Arthur G. Henry, William P. Woodside, Albert E. White and W. H. Eisenman. Members of the Society are invited, along with an important guest list from industry, education and government, to participate in the dedication ceremonies.

It was just a year ago, on Sunday, Aug. 23, 1959, that the Board of Trustees inspected the new National Headquarters and held its first formal meeting in the new building. Clarence H. Lorig, then president of the Society, presided at this session. He had been appointed by the Board in 1958 to carry forward the construction of the building, following the death of Bill Eisenman on May 30, 1958.

"Make no little plans . . . ", the phrase that Bill Eisenman had quoted so often during the years of his leadership as long-time A.S.M. secretary, applies most aptly to this shimmering, spacious showcase of metals that serves so efficiently as the offices of A.S.M.'s headquarters staff.

The giant geodesic dome towering to the height of 103 ft. and spanning a diameter of 274 ft. has already become a landmark in the greater Cleveland area. More than 25,000 visitors have viewed the structure during the first year of occupancy.

Many of the metals that A.S.M. members so expertly produce and fabricate are presented in the new headquarters. As conceived by the architect, John Terence Kelly, and approved by the Board of Trustees, the new A.S.M. headquarters involves three major elements.

First, there is the mineral garden which already displays nearly 100 specimens of ore that have been contributed to the Society. Second, the gleaming geodesic dome of aluminum, largest of its type and designed by R. Buckminster Fuller, centers on and soars above the mineral garden.

And, third is the semicircular three-level headquarters building itself. Stainless steel is the keynote of the structure. Most dramatic feature is the sunshade that sets 18 in. outside the upper level window wall and completely surrounds the building on the westerly side. Fabricated of stainless steel sheets, with stainless "eyebrows" welded over openings in the sheets, the sunshade keeps out the afternoon sun while permitting a view of the beautiful rolling hills of the countryside. Stainless steel is also used on all exterior and many interior doors on the plaza level, in the featured central stairway, and in the modern kitchen and cafeteria.

Copper and brass in perforated panels are displayed in the central stairway, and in handrails in all three of the building's stairways. The elevator also features beautiful brass doors on all three levels.

Titanium is used for the legs of the Board of Trustees table, and stainless is again featured with the Canadian birch paneling in the Board Room that was contributed by the Canadian Chapters of the Society.

"This truly magnificent building of metals cannot be described, cannot be effectively pictured", says Allan Ray Putnam, managing director of the Society. "It must be seen and *experienced* for a full appreciation of the metallic achievement that was conceived by the late Bill Eisenman and by the Trustees who approved the plan and carried it to completion. Most certainly, this new headquarters will stand for years to come as a tribute to the philosophy, 'Make no little plans'."

Following the invocation, Zay Jeffries will present a biographical memoir honoring Mr. Eisenman and his contributions to the development of A.S.M., after which a bust of Mr. Eisenman, presented by the Trustees, will be unveiled. Later it will be permanently installed on a stainless steel pedestal to be located along with large paintings of the founder members in the lower level memorial area.

The featured dedication address will be presented by Clyde Williams, Clyde Williams and Co., former president of Battelle Memorial Institute, and long-time member A.S.M.

Walter Crafts, president of the Society, will preside throughout the dedication ceremonies, which will include the unveiling of a formal bronze plaque at the entrance to the building, and the emplacement of a stainless steel time capsule.

The dedication ceremonies will take place under the "Roof of Sky" provided by the geodesic dome, to be followed by inspection tours of the headquarters building and operations.

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Orders must reach
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All of the following papers accepted by the A.S.M. Transactions Committee will be preprinted for distribution to members of the American Society for Metals upon request. All papers will subsequently be published in A.S.M. Transactions.

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199. **Phase Relations in the Magnesium-Rich Region of the Mg-Al-Zn Phase Diagram,** by J. B. Clark, Metallurgical Lab., Dow Metal Products Co., Midland, Mich.
200. **The Structure and Mechanical Properties of Uranium-Titanium Martensites,** by D. L. Douglass, General Electric Co., Schenectady, N.Y.
201. **Laves-Type Phases of Hafnium,** by Rodney P. Elliott, Metals Research Division, Armour Research Foundation, Chicago.
202. **Effect of Rolling Procedure on the Kinetics of Recrystallization of Cold Rolled Iron,** by J. T. Michalak, United States Steel Corp., Monroeville, Pa., and W. R. Hibbard, Jr., General Electric Co., Schenectady, N.Y.
203. **Embrittlement of High-Purity Nickel,** by K. M. Olsen, C. F. Larkin and P. H. Schmitt, Jr., Bell Telephone Laboratories, Inc., Murray Hill, N.J.
204. **Metal Wear by Scoring,** by J. H. Olson and R. D. Chapman, Engineering Div., Chrysler Corp., Detroit, Mich.
205. **Dynamic Stress-Strain Phenomena and Plastic Wave Propagation in Metals,** by Ralph Papirno and George Gerard, College of Engineering, New York University, N.Y.
206. **The Isothermal Transformation of Ti-13V-11Cr-3Al,** by L. E. Tanner, Manufacturing Laboratories, Inc., Cambridge, Mass.
207. **Oxidation of Zirconium-Columbium Alloys in Oxygen at 525 to 1090°C.,** by Otto Zmeskal, University of Toledo, Toledo, Ohio, and Mary L. Brey, University of Florida, Gainesville.
208. **Preferential Corrosion of Stabilized Stainless Steel Welds,** by C. L. Angermann and P. Kranzlein, E. I. du Pont de Nemours & Co., Aiken, S.C.
209. **The Effect of Microstructure on the Fatigue Strength of a High-Carbon Steel,** by F. Borik and R. D. Chapman, Metallurgical Research, Chrysler Corp., Detroit.
210. **Constitution of the Partial System: Uranium Monocarbide-Uranium Dicarbide,** by W. Chubb and W. M. Phillips, Battelle Memorial Institute, Columbus, Ohio.
211. **Factors Controlling the Occurrence of Laves Phases and AB_5 Compounds Among Transition Elements,** by A. E. Dwight, Metallurgy Division, Argonne National Laboratory, Argonne, Ill.
212. **Hydrogen Embrittlement in Vanadium-Columbium Alloys,** by A. L. Eustice and O. N. Carlson, Institute for Atomic Research, Iowa State College, Ames.
213. **The Solid-State Constitution of High-Uranium Alloys of the Uranium-Zirconium-Silicon System,** by M. S. Farkas, A. A. Bauer and R. F. Dickerson, Battelle Memorial Institute, Columbus, Ohio.
214. **A New Series of Nickel-Base Alloys for Advanced Temperature Applications,** by J. C. Freche, W. J. Waters and T. J. Riley, NASA Lewis Research Center, Cleveland.
215. **On the Morphology of Pro-Eutectoid Cementite,** by H. W. Paxton, Carnegie Institute of Technology, Pittsburgh, Pa., and R. W. Heckel, E. I. du Pont de Nemours & Co., Wilmington, Del.
216. **Grey and White Solidification of Cast Iron,** by Dr. M. Hillert, Swedish Institute for Metal Research, Stockholm, Sweden.
217. **Precipitation of Phosphorus From Alpha Iron and Its Effect on Plastic Deformation,** by E. Hornbogen, U.S. Steel Corp., Research Center, Monroeville, Pa.
218. **The Tensile Properties of Type 410 Stainless Steel Deformed Before and After Martensite Transformation,** by K. E. Pinnow, Pennsylvania State University, University Park, and Yuzo Hosoi, National Research Institute, Tokyo, Japan.

219. **Yield Point Phenomena in a Number of Commercial Copper Alloys and One Nickel-Base Alloy,** by R. B. Jones and V. A. Phillips, Alloy Studies Section, General Electric Co., Schnectady, N.Y.

220. **High-Strength Martensitic Steels for Elevated-Temperature Use,** by A. Kasak, V. K. Chandhok and E. J. Dulis, Crucible Steel Co. of America, Pittsburgh, Pa.

221. **Effects of Alloying on the Oxidation Behavior of Tantalum,** by W. D. Klopp, D. J. Maykuth and R. I. Jaffee, Battelle Memorial Institute, Columbus, Ohio.

222. **The Occlusion of Hydrogen by Annealed Hypo-Eutectoid Iron-Carbon Alloys,** by M. Kotyk and H. M. Davis, Pennsylvania State University, University Park.

223. **Low-Temperature Flow and Fracture Tension Properties of Heat Treated SAE 4340 Steel,** by F. R. Larson and J. Nunes, Ordnance Corps, Watertown Arsenal Laboratories, Watertown, Mass.

224. **The Effect of Aluminum of Strain Aging and Internal Friction in Low-Carbon Steel,** by F. H. Laxar, D. J. Blickwede and J. W. Frame, Physical Metallurgy, Bethlehem Steel Co., Bethlehem, Pa.

225. **Cylindrical Textures in Tungsten and Other Body-Centered-Cubic Metals,** by S. Leber, General Electric Co., Cleveland, Ohio.

226. **The Microstructure of Low-Carbon 3.25% Silicon Steel,** by W. C. Leslie and R. L. Rickett, U.S. Steel Corp., Research Center, Monroeville, Pa.

227. **Improvement of the Ductility of Vanadium by Alloying,** by D. T. Klodt and C. E. Lundin, Denver Research Institute, University of Denver, Colo.

228. **The Determination of Hardness in Steels From the Breadth of X-Ray Diffraction Lines,** by R. E. Marburger and D. P. Koistinen, Physics Department, General Motors Corp., Warren, Mich.

229. **Effect of Induction Tempering on 500° Embrittlement,** by J. F. Libsch and A. Nakashima, Lehigh University, Bethlehem, Pa.

230. **Diffusion of Carbon in Thorium,** by D. T. Peterson, Institute of Atomic Research, Iowa State University, Ames.

231. **Yield Point and Order-Hardening Phenomena in Some Commercial 'Nickel Silver' Alloys,** by V. A. Phillips and R. B. Jones, General Electric Co., Schenectady, N.Y.

232. **Mechanism of Rapid Intergranular Oxidation of 18Cr-8Ni Stainless Steels by Oxygen and Dry Sodium Chloride in the Temperature Range 1100°-1400°F.,** by M. G. Fontana, F. H. Beck and H. W. Pickering, Ohio State University, Columbus.

233. **Mechanical Properties of Tantalum-Base Alloys,** by F. F. Schmidt, F. C. Holden, H. R. Ogden and R. I. Jaffee, Battelle Memorial Institute, Columbus, Ohio.

234. **The Effect of Cold Work and Temperature on Strength and Structure of Steel,** by P. Shahinian and M. R. Achter, U. S. Naval Research Laboratory, Washington, D.C., and W. A. Pennington, University of Maryland, College Park.

235. **A Study of the Liquidus in Aluminum-Uranium Alloys,** by V. W. Storhok, A. A. Bauer and R. F. Dickerson, Battelle Memorial Institute, Columbus, Ohio.

236. **Solubility of Oxygen in Delta Iron,** by N. A. Gokcen and E. S. Tankins, University of Pennsylvania, Philadelphia.

237. **On the Mechanism of Occlusion of Hydrogen by Cold Worked Hypo-Eutectoid Iron-Carbon Alloys,** by H. M. Davis and J. E. Werner, Pennsylvania State University, University Park.

238. **Temperature and Microstructure Dependence of Size Effect in Notched Bend Tests of Some Alloy Steels,** by S. Yukawa, General Electric Co., Schenectady, N.Y.

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199	204	209	214	219	224	229	234
200	205	210	215	220	225	230	235
201	206	211	216	221	226	231	236
202	207	212	217	222	227	232	237
203	208	213	218	223	228	233	238

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Proposed Constitution Changes

As required by the Constitution of the American Society for Metals, notice is hereby given of amendments to be proposed, for membership approval, at the Annual Meeting of the Society at 9:00 a.m., Wednesday, Oct. 19, at the Bellevue-Stratford Hotel, Philadelphia, Pa. Changes and additions are shown in boldface.

ARTICLE V

FEES AND DUES

PRESENT CONSTITUTION

Amount

Section 1. The annual dues shall be as follows:

Members	$10.00
Student Members	2.50
Sustaining Members— not less than	25.00

Any member who becomes a Life Member shall thereafter be exempt from payment of dues, if he so requests. Founder Members, Honorary Members and Honorary Life Members shall not be required to pay dues.

Section 2. All dues shall be paid to the order of the Secretary of the Society. Dues collected from members of a local Chapter may be collected by the local Chapter, but shall be immediately transmitted in full to the Secretary of the Society.

PROPOSED CHANGES AND ADDITIONS

Amount

Section 1 **(a). An initiation fee of $5.00 shall be payable by each applicant for membership as a member or sustaining member. Such fee shall accompany the application, but shall be returned to the applicant if the applicant is not accepted**

(b) Annual **membership** dues shall be **payable** as follows:

by each Member	$10.00
by each Student Member	2.50
by each Sustaining Member— not less than	25.00

Any member who becomes a Life Member shall thereafter be exempt from payment of dues, if he so requests. Founder Members, Honorary Members and Honorary Life Members shall not be required to pay dues.

(c) Each applicant for reinstatement to membership as a member or sustaining member shall pay a fee of $5.00, which shall accompany the application. If the application is not accepted the fee shall be returned.

Section 2. All **fees and** dues shall be paid to the order of the Secretary of the Society. **Fees and** dues collected from members of a local Chapter may be collected by the local Chapter, but shall be immediately transmitted in full to the Secretary of the Society.

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Role of Martensite in the Hardness of Steels

NOT TOO MANY YEARS AGO, Morris Cohen, Massachusetts Institute of Technology, told New York Chapter members, a steel with 200,000 psi. strength was considered exceptional. Today we have steels approaching 500,000 psi. in strength. While the preparation of such high-strength steels depends largely on the formation of martensite, the fundamental reasons for strength of the steel and for hardness of the martensite itself are only imperfectly known.

In exploring the possible underlying causes for these phenomena, Prof. Cohen described some new research results obtained by Peter Winchell, formerly a candidate for a doctor's degree at M.I.T. and now at Purdue University.

By separating the role of carbide precipitation from that of solid-solution hardening, it is possible to show that 80 to 90% of the hardness of as-quenched martensite appears to be attributable to the solid-solution effect.

This conclusion stems from an interesting experimental procedure. A series of iron-nickel-carbon alloys having carbon levels up to 1% were prepared; the carbon-nickel balance was adjusted so that all alloys had the same subzero starting temperature, about —35°C., for the austenite-to-martensite transformation. The object was to form martensite at such low temperatures that the carbon would not diffuse or precipitate out of solution and thus decompose the martensitic structure before its properties could be determined. The alloys were quenched to various temperature levels down to that of liquid nitrogen and the properties measured at 0°C. By plotting the flow strength against percentage of martensite present and extrapolating to 100% martensite, it was found that the flow strength (at 0.6% plastic strain) of the "pure" martensite ranged from 80,000 to 275,000 psi., depending on the carbon content.

However, it was then discovered that even the low temperatures employed for the mechanical testing had not prevented martensite from beginning to decompose before being tested. The influences of the two mechanisms were finally separated. The resulting curve for the solid-solution effect alone showed that it makes no further contribution to strength above 0.4-0.5% carbon content; the additional strength of higher carbon steels appears to be due primarily to the precipitation effect.

Dr. Cohen also reviewed various efforts being made to strengthen steel by introducing additional strain hardening. In the austforming process, the austenite is severely worked—generally by rolling—before being quenched to form martensite. The result is an extremely fine martensitic structure with ultimate tensile strengths that already approach 500,000 psi. in some steels. Ductility is relatively low but may be sufficient for certain high-strength applications. In many cases the ductility is higher as-quenched than after tempering.

Eugene S. Machlin, Morris Cohen, Leslie Seigle and Ludwig Anselmini Discuss Dr. Cohen's Talk on "Martensite's Hardness" at New York

Some of the strengthening effect of austforming can be attributed to the creation of "substructure" (slight differences in orientation of planes) within individual crystals. Such effects have been observed in work done at the University of California in which nonferrous metals were prestrained by definite amounts.

One hardening mechanism for martensite postulated by some, namely the strengthening of the bond between iron atoms, can be discarded, Dr. Cohen said. Tests show that as the percentage of martensite in a steel increases, modulus of elasticity decreases; this relationship would indicate that the bond between iron atoms in martensite is weaker, not stronger, than in other steel structures. *(Reported by Bruce Fader).*

Materials for Use in Thermal and Space Vehicles

PROBLEMS RELATED TO AERODYNAMIC heating, propulsion principles, nuclear aspects, generation and control of electrical power and satellite skin heating were discussed by W. S. Pellini, superintendent, Metallurgy Division, U. S. Naval Research Laboratory, in Richmond in a talk entitled "Application of Materials to Thermal and Space Flight Vehicles". Solutions have been worked out within the limitations of existing materials and better solutions will come with the development of new materials.

Aerodynamic heating of a vehicle occurs within the region of the atmosphere, called the thermosphere, which extends some 60 miles above the earth's surface. Hot regions first develop along leading edges of a vehicle as its velocity exceeds that of sound. For higher velocities, the temperatures increase to a point such that cooling must be applied. For radiative cooling techniques it is necessary to have surfaces of high emissivity. Variations of radiative cooling include insulated surfaces with a coolant placed against the insulation of the structural shell; and a liquid metal heat transfer pump to move the heat from critical areas to areas where it can be radiated. Strictly absorptive systems include ablative shell which vaporizes, layer by layer, to protect the inner layers; and transpiration, which vaporizes water or gases through a porous wall.

Temperatures generated at the nozzles of engines during combustion of the propellant may reach 6000°F. When burning times are short, steel walls can absorb this heat. For burning times of 1 min. or more it is necessary to protect the throat section by lining it with molybdenum or tungsten.

Mr. Pellini described several space vehicles which were in various stages of operation and design. Among these were the "Jupiter C" which carries a 100-lb. payload, and the Nova, which is designed to carry a 4000-lb. payload to Venus, or put a 150.000-lb. payload in a 300-mile orbit of the earth. Others described were the Thor, Able, Atlas, Centaur and Saturn.

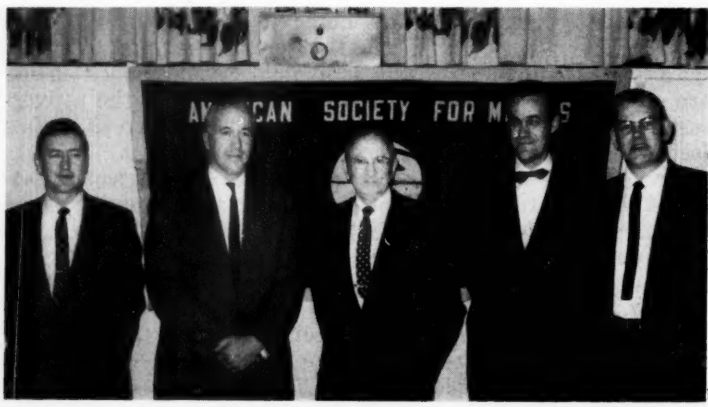
Several propulsion systems were described. To send a 1000-lb. payload into escape velocity of 25,000 mph., a nuclear system would weigh approximately 20,000 lb., an H_2-O_2 or H_2-F_2 system 400,000 lb., and a conventional system 8,000,000 lb. These would consist of one, two and three stages, respectively. Once the near-earth gravity's pull was overcome, propulsion may be by arc jet, electrostatic or electromagnetic systems.

An orbiting payload which is heated by radiation from the sun or cooled by radiation to space, must be protected from damage by temperatures which may vary from several hundred degrees Fahrenheit below zero to several hundred degrees above. Delicate instrumentation is maintained at a constant temperature by painting, polishing and shuttering of the shell in various ways. The controls are based on principles of optical properties of surfaces.

A series of four articles by Mr. Pellini and associates is currently appearing in *Metal Progress*. These describe thermal aspects of high speed flight and discuss capabilities of present and future materials for meeting requirements. *(Reported by W. W. Berkey).*

Columbium and Its Alloys

E. M. MAHLA, TECHNICAL MANAGER, Metal Products, Pigments Dept., E. I. du Pont de Nemours & Co., spoke on "Metallurgy of Columbium and Its Alloys" at Wilmington. Dr. Mahla surveyed available information on the present status of the free world's efforts to produce strong, fabricable, corrosion-resistant columbium alloys, mainly to perform at higher temperatures the work presently done by the



Hardness Testing

D. J. Coleman, Technical Chairman; A. L. Stowe, Chairman; V. E. Lysaght, American Chain & Cable Co., Inc., Who Spoke on "Hardness Testing"; R. L. Mark, Chairman, American Society for Quality Control; and F. B. Olson, A.S.Q.C., Shown at a Meeting in Worcester

Bradley Stoughton Award

Shown Receiving the First Bradley Stoughton Student's Award of the Lehigh Valley Chapter Is Thomas R. Richards, Lehigh University. From left are: H. O. Beaver, chairman; Mr. Richards; R. D. Stout, head, department of metallurgy, Lehigh; and J. B. Godshall, vice-chairman

superalloys.

Of the refractory metals, columbium is most attractive owing to nonvolatile high-melting oxides, high melting point, availability from domestic ores, favorable strength-to-weight ratio, low neutron-capture cross section, etc. On this basis, a number of companies, including both potential consumers and producers, have undertaken studies of alloying to enhance various properties of pure columbium.

Achieving a compromise among strength at high temperatures, oxidation resistance and fabricability offers many challenges to modern metallurgy. Typical of work on all refractory metals, relatively recent developments are applied at many processing stages, such as melting into ingots, extrusion and welding. Considerable research is being done on various techniques as well as materials, because the new properties being sought bring along with them new problems in fabrication. For instance, extrusion temperatures for advanced, oxidation-resistant alloys such as du Pont's D41 and its modifications are above the melting points of conventional hot working dies. Dr. Mahla discussed innovations in tooling and techniques to meet such difficulties.

Properties of various proprietory alloys were discussed. The present status of the field and the research underway indicate that properties will be achieved which will make columbium alloys important commercially. *(Reported by J. E. McNutt.)*

Nondestructive Testing in Our Space Age

"NONDESTRUCTIVE TESTING in Our Space Age" was discussed by Justin G. Schneeman, president, X-Ray Products Corp., at Albuquerque.

Mr. Schneeman described the four popular methods of nondestructively checking reliability in a part—penetrant, magnetic particle, ultrasonic and X-ray or gamma-ray.

Regarding techniques important to good radiography, the speaker went into some detail relative to inherent filtration, focal spot size of the X-ray tube, kilovoltage and the proper use of X-ray film holders. He also discussed motion radiography, magnification radiography, X-ray fluoroscopy and xeroradiography.

The inspection and testing of material and processes by nondestructive means and methods has become a highly scientific art with an activity undreamed of ten years ago. This activity will continue. The means and methods may not remain the same but the need for reliability in materials and processes for our space age is and will continue to be important for future progress.

Today we have many new problems that we were not confronted with a few years ago. We need to inspect, with absolute reliability, minute items such as subminiature-size electronics and grain-size structures up to and including such massive items as the components of liquid rocket motors or those driven by solid fuel—from the space giants themselves to their sophisticated and exotic brain and guidance systems.

One should not design a part and let the inspector and testing engineer worry about it. Testing must be designed into it.

X-ray is the most versatile of nondestructive testing methods and with its many new and related developments appears to be destined to remain important inspection media.

A variety of X-ray tubes and film add to the versatility of radiography. With all this equipment and choice of materials it is now possible to produce radiographs of precision and clarity. Some radiographs contain so much data that it is difficult to explain to some interpreters that the additional details are not necessarily defects but are in addition to the normally shown discontinuities. This, in many instances, shows the true extent of a discontinuity and thereby should make for easy interpretation. It is this type of radiograph that one should strive for whenever possible.

Today's modern fluoroscope is well able to disclose many material discontinuities of a magnitude almost as good as radiography. In addition

(Continued on p. 20)

to straight fluoroscopy, we now have several devices to enhance the fluoroscopic image, such as electronic image intensifier, TV systems and other image intensifying and sensing devices.

We can now, by means of a fluoroscope system, take motion pictures of parts such as switches in action. The quantities of light available are sufficient to take enough frames per second to actually re-project them in slow motion. So the fluoroscope has become a tool that should be given serious consideration in any nondestructive testing and inspection program. Fluoroscopy is a good method for "weeding out" the bad pieces before sending them to radiography.

The nature of the product to be inspected generally dictates the means of inspection. However, the various inspection systems available have their inherent advantages and limitations and it is these factors, as well as the individual functions of each method, that must be known by the one who is to decide as to the best procedure for the problem at hand. *(Reported by E. H. Mebs.)*

Advantages and Uses of Cold Extrusion Processes

R. W. GARDNER AND W. W. WISHART, senior engineer, Research and Development Center, and chief metallurgist, respectively, Verson Allsteel Press Co., discussed "Cold Extrusion" at Peoria.

Mr. Gardner pointed out that there are many advantages to cold extrusion that other methods of forming (including machining) do not have. The strength advantage of flow lines, for example, and improvement in physical properties due to cold working are important aspects of cold extrusion. Dimensional sizes can be held within 0.001 in., which makes cold extrusion practical for an almost finished product upon completion of the operation. While basically the tooling used for cold extrusion is simple, the massiveness of the die tooling compared to other punch presses is impressive. Mr. Gardner showed approximately 100 slides to illustrate the various kinds of cold extrusion products, equipment and processes. He explained that a coining or upset operation sometimes precedes the actual extrusion process. Then, after the proper coating and lubrication has been applied, the prepared slug is backward extruded, forward extruded or combination extruded. Sometimes it is necessary to go through a series of extrusion processes accompanied with process annealing to obtain the finished product. Cold extrusion principles and equipment are basically simple and are complexed only by automation.

Mr. Wishart discussed the metallurgical aspects of the cold extrusion of steel. For acceptable tool life the plain carbon materials may have 0.08-0.35% carbon. Carbon, in the form of pearlite, when the carbon is below 0.20%, will extrude properly, but when the carbon is above 0.20%, the pearlite should be spheroidized. The ferrite hardness should be kept at a minimum also and, therefore, silicon, phosphorous, manganese and other ferrite hardeners should be kept low. Some phosphorous helps during machining operation; however, it should be held close to 0.015% for cold extrusion. On most SAE grades there is a 0.04% maximum limit on phosphorous. Unfortunately, this amount would be detrimental to the cold extrusion process; however, most steel mills produce a product with a tolerable amount of phosphorous. When buying steel for extrusion, an unsound internal structure and surface condition, such as strings due to MnS or dirt and laps, seams, etc., are detrimental and should be considered.

Full anneal or subcritical anneal is necessary to soften the material during intermittent stages of some extrusion processes. While a proper anneal will increase tool life, the main reason is to decrease the yield strength of the material so that necessary extrusion pressures will be held to a minimum. The tooling used for cold extrusion is high-speed toolsteel with a hardness of Rockwell "C" 60-65. It is given a triple draw to transform the retained austenite and obtain a more wear resistant material. *(Reported by W. T. Bott.)*

W. W. Wishart, Fred W. Zapf, R. W. Gardner and T. W. Peck Are Shown at a Peoria Meeting During Which Mr. Wishart and Mr. Gardner Discussed "Cold Extrusion"

Russian Versus Western Metallurgical Education

"METALLURGICAL EDUCATION — East Versus West" was the subject of a talk by Joseph W. Spretnak, Ohio State University, at the High School Science Night meeting held by the Dayton Chapter.

Dr. Spretnak defined metallurgy and metallurgical engineering and outlined the wide scope of activity covered by this scientific field. He charted the historical development of science as a field of endeavor from 1600 A.D. to the present and showed that metallurgy as a science has flourished only in relatively recent years. World War II was considered the real impetus for the expansion of metallurgical science on a worldwide basis. The many demands on metals and alloys during World War II forced the major nations to emphasize this important activity for survival and since that time the rapid rate of progress in metallurgical research has continued. It is now one of the most important scientific fields and is no longer being considered largely as an art, as it was just prior to the pre-World War II era.

Because of this increased interest in all sciences, including metallurgy, it is necessary to maintain an active educational pace if the Western nations wish to keep their scientific equality or superiority over those under the influence of Russia.

Dr. Spretnak reviewed Russian developments in the scientific field and particularly emphasized that metallurgy is a subject of intense interest to them. Metallurgy appears to rank second only to physics in importance and therefore is one of the elite fields of activity from their standpoint. Many more metallurgists are being trained in Russia than in the United States; in fact, two "metallurgical institutes" located in Moscow have a combined enrollment greater than the total undergraduate enrollment in metallurgy in the United States. Much of their very recent endeavor is in the field of basic research which should greatly strengthen their position in years to come.

The present Russian technique is to have the various "institutes" specialize in one or more phases of metallurgy, thus hoping to get the maximum result from their specialization. Russian students are subsidized during their training to make certain their education progresses satisfactorily, and every effort is made to use their talents to best advantage.

The Russian program of scientific education at the grade and high-school levels was compared to that of the United States. The basic education given these young students by the Russians strongly emphasizes the classical fields of basic sciences, mathematics and languages. Since the curricula for the elementary and secondary schools is standardized by the Ministry of Education, the strong grounding in science for all suggests an attempt to make science one of the basic foundations of Soviet culture. By way of suggestion, it was Dr. Spretnak's opinion that a more classical curriculum with a proper emphasis on science and mathematics would enhance our position in the scientific field and improve our competitive position for future development. A necessary ingredient in our society is the development of a greater appreciation and understanding of the power and worth of the disciplined intellect and the field of ideas and abstract thinking. Out of such serious contemplation can evolve the proper destiny of Western civilization and the fulfillment of all mankind. *(Reported by Walter A. Luce for the Dayton Chapter.)*

J. W. Spretnak, Ohio State University, Spoke on "Metallurgical Education—East Versus West" at a Dayton Meeting. Shown are, from left: A. M. Adair, Dr. Spretnak, R. J. Raudebaugh and D. C. Heckard

Arizona Student Receives A.S.M. Scholarship

Len I. Van Torne, Senior in Metallurgical Engineering, University of Arizona, Receives a $500 A.S.M. Scholarship From Allan Ray Putnam, Managing Director, A.S.M.; M. A. Scheil, National Trustee; and B. C. Natta, chairman of the Student Group, look on

R. B. LUCAS MEMORIAL Scholarship awards of $500 each were presented to three Calumet Area high-school seniors by the Calumet Chapter at a recent meeting.

William Ralph Hunter, 18, of Homewood, Ill., is graduating from Bloom Township High School in Chicago Heights, and plans to follow a course of studies leading to electrical engineering, with electronics or physics option, at Princeton.

Carole Lynn Moats, 18, Hammond, Ind., is graduating from Oliver P. Morton High School and has been accepted by Purdue University to follow a course of studies leading to a degree in mechanical engineering.

Adolph Vincent Mrstik, Jr., 18, Floosmoor, Ill., is graduating from Bloom Township High School and is enrolled in the course of studies leading to electrical engineering, electronic option, at the University of Illinois.

Vacuum Melting of High-Temperature Materials

"THE EFFECT OF VACUUM Melting on the Properties of High-Temperature Materials" was explained at Canton-Massillon Chapter by Frank M. Richmond, manager of research and development, Universal-Cyclops Steel Corp.

Mr. Richmond covered the field of vacuum melting of high-temperature alloys from its inception to its present status. The need for this type of melting arose when the limitations of strength with nominal ductility and workability had been reached by conventional melting techniques. This was particularly true for nickel-base superalloys which showed a maximum temperature rating in 1950 of 1600°F.

In 1953 the popular high-temperature alloys were M-252, Waspaloy and A-286. All of these use titanium and aluminum as hardening agents. Since that time increases in hardener content, made possible by vacuum melting, have improved the high-temperature properties of M-252 and Waspaloy at the 1500°F. level. Two other new alloys which have been developed as a direct result of vacuum melting are Unitemp 500 and Unitemp 1753, which have temperature ratings as high as 1675°F. In addition to its higher temperature rating, Unitemp 1753 has excellent workability for an alloy of this type.

All of the currently popular nickel-base superalloys use small amounts of boron (0.005%) and zirconium (0.05-0.10%) to enhance their high-temperature properties. The time to rupture of J-157 (one of the newer alloys) at 1650°F. and 20,000 psi. stress was increased from 18 to 115 hr. by these additions. Similar increases have been obtained in Waspaloy, M-252, etc.

These alloys were melted in tilting-type, 1000 and 2000-lb. induction furnaces and were poured into ingot molds set on a turntable. This equipment was completely enclosed and operated under vacuum. By melting and casting under vacuum, it was found that silicon and manganese were not required for deoxidation. The elimination of these elements improved the stress-rupture properties of the alloys. Using these techniques also gave a cleaner metal which resulted in higher fatigue strengths.

Consumable electrode melting into water-cooled copper crucibles has also been used to further improve the properties of the various alloys, particularly through improved grain structures. A combination of these two operations, vacuum induction melting followed by consumable electrode melting, termed "Duovac", has resulted in the best alloy material, showing clean grains as well as uniform ingot structure.

Bearing steels which require low inclusion ratings, as well as high-tensile toolsteels, are now being melted by these techniques. Vacuum degassing is also gaining popularity in standard steel practice to minimize the flaking problem.

Metals to be used in such applications as jet engine and missile components have more particularly benefited by the development of vacuum technology. *(Reported by John Savas).*

METALLURGICAL NEWS AND DEVELOPMENTS

TITANIUM MISSILE CASING

A report issued by Aerojet-General Corp. states that a solid fuel motor for the Minuteman third stage, using a casing made entirely of titanium, said to be one-third lighter than conventional steel casings, has been successfully fabricated and fired. If adopted on a production basis, titanium casings could add significantly to the range of the missile. In the test reported, the motor case survived so well that it was scheduled to be cleaned, reloaded with propellant and used again in another test firing.

GAS ALLOYING OF STEEL

Recently revealed in Cleveland was a method of producing steel alloys by means of gases introduced during the annealing of commercial-size coils of rolled steel. The process is said to make economically feasible the addition or removal of carbon, nitrogen and other alloying elements that can be gasified during the annealing cycle. The new alloying method is an outgrowth of an open coil annealing process in which air spaces are provided between laminations of a coil being treated. Hot gases are then directed through the air spaces to achieve faster, more thorough and uniform heating. One example of how the new process is being used is in the production of "direct-on" enamelling steel. In this instance, the carbon content of the steel can be lowered to such values that it becomes unnecessary to use two coats of enamel to insure high quality whites and other light colors.

METAL WEAR SCIENCE STUDIED

Ten leading U.S. corporations have united to sponsor research intended to unravel some of the mystery which has always surrounded the wear of metals. By understanding the complete mechanics of wear, researchers might then be able to select and develop alloys capable of lasting longer under severe service conditions. A new family of experimental machines is being developed at Armour Research Foundation to study metallic wear and friction. In the equipment, metal will be forced to wear and extent of wear will be determined by measuring weight loss, changes in dimension and surface damage. Measurements will be made for a selected group of alloys and from these data general conclusions can be made for the wear and friction of other alloys.

CERAMIC COATED MUFFLERS

The first use of ceramic coated mufflers as original equipment on automobiles will be a feature of the 1961 Rambler. It is hoped that this will prove to be a potent sales tool through its promise to substantially reduce, if not eliminate, the frequent replacement of tail pipe and muffler assemblies. Automobile industry experts guess that the new coating system will add about $1.50 to the manufacturing cost of each automobile. Ceramic coatings have been used extensively on certain parts of jet engines and rockets, but this is one of the first applications on mass production consumer goods.

REFRACTORY METAL WELDING

Researchers seeking to develop the most satisfactory methods of welding refractory metals to dissimilar metals look to ultrasonic welding as the most likely solution to the problems resulting from fusion welding methods. Certain combinations are now being joined satisfactorily, but more study appears necessary to overcome cracking which develops in some metals at the edge of the bond area. The cracks appear to be caused by fatigue resulting from the high alternating stresses present at the edge of the weld area during ultrasonic welding. The most satisfactory welds from all points of view have been obtained in stainless steel-to-iron-to-columbium welds.

HIGH LOAD CAPACITY LUBRICANT

The addition of various inorganic sulphides to the well-established lubricant, molybdenum disulphide, increases the load bearing capacity by as much as 20 times. Among the more effective additives, which are added in quantities of approximately 10 percent by weight, are the sulphides of antimony, platinum, mercury, silver, titanium and lead.

DUCTILE SINTERED REACTOR MATERIALS

Aluminum plus boron or rare earth oxides is now more readily available for nuclear applications through an advanced powder metallurgy technique. By usual alloying techniques, even small amounts of these additives caused the aluminum to become too brittle for most fabrication processes. As an example of the product being made by the sintering process, boron carbide uniformly dispersed in an aluminum matrix can be produced in a continuous strip which can be wound into coils and cylinders or fabricated into other shapes. Composite materials made by the process can contain up to about 30%, by volume, of oxides, carbides, borides or intermetallic compounds.

EMPLOYMENT SERVICE BUREAU

Operated on a no-charge basis for A.S.M. members in good standing. Ads are limited to 50 words and only one insertion of any one ad. Address answers to: Box No., American Society for Metals, Metals Park, Novelty, Ohio, unless otherwise stated.

POSITIONS OPEN

East

METALLURGIST: Experienced in manufacture of metals for semiconductors, including gold and doped gold clad on Moly and Kovar, tin and tin-lead clad on nickel, etc. Good pay and excellent opportunity for growth. Location: Suburban New York. Box 8-5.

MANUFACTURING ENGINEER: Experienced in the metallurgy and production of silver brazing alloys in wire and strip form, also with brazing alloys clad on base metals. Salary commensurate with background. Located in Queens, New York City. Box 8-10.

Midwest

FURNACE SALES ENGINEERS: Excellent opportunity with rapidly expanding concern to sell all types of heat treating, melting, plating and washing equipment. Experience in actually selling these items is desired. Openings in principal cities. Unlimited future. Send resume and salary requirements to: Metal Treating Equipment Exchange, 9825 Greeley, Detroit 11, Mich.

METALLURGIST: Manufacturer of specialty steels desires metallurgical engineer, age 24 to 30, to take charge of a small metallurgical laboratory mill located in the Chicago district. Applicant must be in good physical condition and have completed his military service requirements. The work involves quality testing and research on product production problems. Applicant should have a personality that makes him adaptable to customer contacts. Salary commensurate with experience. Box 8-15.

RESEARCH AND DEVELOPMENT METALLURGICAL ENGINEER: M.S. (preferred) and B.S. Research and development programs involve high-temperature, ferrous materials, protective coatings, powder metallurgy and iron, nickel and cobalt-base alloy development. Work assignments on a responsible project level. Laboratory equipped with modern high-temperature facilities. Send complete resume: Box 8-20.

West

REPRESENTATIVE: Excellent opportunity for well-qualified man to represent large salt bath furnace manufacturer in Los Angeles area. Electric and gas fired salt baths as well as other types of gas fired furnaces are involved. Manufacturer has many installations in Southern California. Send complete resume: Box 8-25.

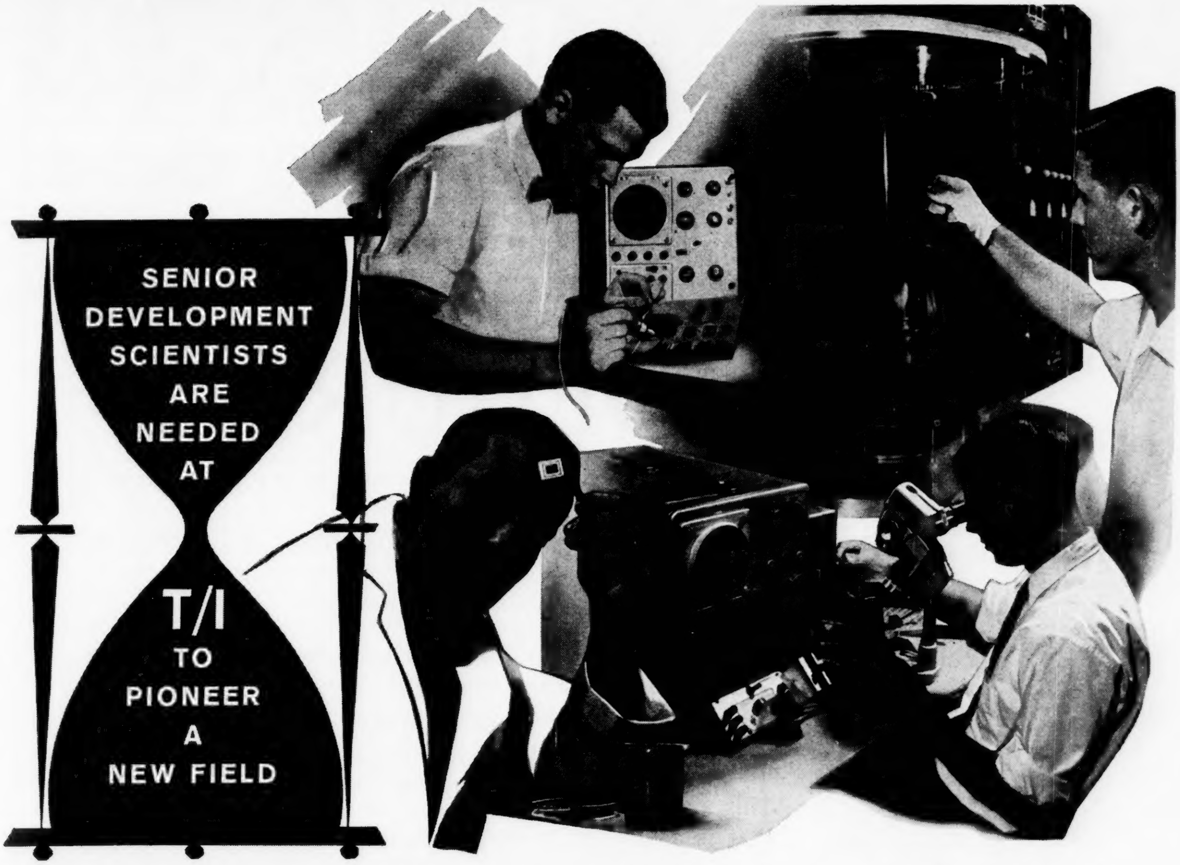
METALLURGISTS: Two. $800-1100 per month, depending on experience. Work with dispersion strengthening, powder metallurgy, exothermic reactive joining and bonding of tungsten and graphite. Similar high-temperature experience desired. Write to: E. P. Carmichael, Narmco Industries Inc., 8125 Aero Dr., San Diego 11, Calif.

POSITIONS WANTED

METALLURGICAL ENGINEER: B.S. age 34, veteran, family. Three and one-half years as research project engineer on wrought and cast stainless steels and high-temperature alloys. Over six years' experience as metallurgist and cupola supervisor in high production gray iron foundries. Desires career position in production supervision or metallurgical development. Box 8-30.

CHIEF METALLURGIST: Wide foundry and plant experience. Has published papers and delivered talks on inspection, cost, acid, basic and water-cooled cupolas and high-test irons. Patents on special irons. Traveled as foundry engineer. Desires position as foundry superintendent or assistant plant manager. Age 43, degree, resume on request. Box 8-40.

PHYSICAL METALLURGIST: Ph.D. in physical metallurgy. Six years research experience in nuclear metallurgy, in addition to university work. Desires position working in Europe, England preferred. Willing to spend several months of each year in North America, as well as an induction period at the American headquarters. Box 8-45.



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The need is for the scientist or engineer sufficiently experienced that he can explore this project from his own viewpoint and make immediate, significant contribution. Depending entirely on his own qualifications, he may either join a semiconductor network team — or he may take charge of such a group. The opportunity for leadership — whether immediate or in the future — is here.

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This — in actual size — is an interconnected stack of 11 semiconductor networks. *Solid Circuit* semiconductor networks are complete electronic circuits synthesized within a semiconductor material. By selectively diffusing and shaping conductance paths in this material, semiconductor networks have been designed to perform such circuit functions as amplification, switching, counting, pulse generation, etc. In addition to effecting a significant advance in microelectronics, semiconductor networks provide improved reliability and performance. This TI development is now producing devices which are being evaluated for satellite, missile and airborne applications.

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The 15th METALLOGRAPHIC EXHIBIT

Philadelphia, October 17 to 21, 1960

All metallographers—
everywhere—
are cordially invited to
display their best work.

RULES FOR ENTRANTS

Exhibitors do not need to be members of the American Society for Metals.

Work which has appeared in previous metallographic exhibits held by the American Society for Metals is unacceptable.

Photographic prints should be mounted on stiff cardboard, extending no more than 3 in. beyond edge of print in any direction; maximum dimensions 14 by 18 in. (35 by 45 cm.) Heavy, solid frames are unacceptable.

Entries should carry a label on the *face of the mount* giving:

> Classification of entry.
>
> Material, etchant, magnification and other desirable data.
>
> A brief statement (if desired) calling attention to any unusual aspect of the entry.

The name, company affiliation and postal address of the exhibitor should be placed on the *back of the mount* together with a request for return of the exhibit if so desired.

Entrants living outside the United States should send their micros by first-class letter mail endorsed "Photo for Exhibition — No Commercial Value — May Be Opened for Customs Inspection".

Exhibits must be delivered before Oct. 1, 1960, either by prepaid express, registered parcel post or first-class letter mail, addressed:

Metallographic Exhibit
American Society for Metals
Metals Park
Novelty, Ohio, U. S. A.

CLASSIFICATION OF MICROS

Class 1. Irons and steels, cast and wrought
Class 2. Stainless steels and heat resisting alloys
Class 3. Aluminum, magnesium, beryllium, titanium and their alloys
Class 4. Copper, nickel, zinc, lead and their alloys
Class 5. Uranium, plutonium, thorium, zirconium and reactor fuel and control elements
Class 6. Metals and alloys not otherwise classified
Class 7. Series showing transitions or changes during processing
Class 8. Welds and other joining methods
Class 9. Surface coatings and surface phenomena
Class 10. Slags, inclusions, refractories, cermets and aggregates
Class 11. Electron micrographs using replicas
Class 12. Electron micrographs (transmission)
Class 13. Color prints in any of the above classes
Class 14. Results by unconventional technique

AWARDS AND OTHER INFORMATION

A committee of judges will be appointed by the Metal Congress management which will award a First Prize (a medal and blue ribbon) to the best in each classification. Honorable Mentions will also be awarded (with appropriate medals) to other photographs which in the opinion of the judges closely approach the winner in excellence. A Grand Prize, in the form of an engrossed certificate and a money award of $500 from the Adolph I. Buehler Endowment will also be awarded the exhibitor whose work is judged best in the show, and his exhibit shall become the property of the American Society for Metals for preservation and display in the Society's national headquarters.

All prize-winning photographs will be retained by the Society for one year and placed in a traveling exhibit to the various Chapters.

42nd NATIONAL METAL CONGRESS & EXPOSITION

Philadelphia Trade & Convention Center——Oct. 17 to 21, 1960

Destination Philadelphia October 17

"The rate of advance of metal science is now so rapid that it is quite difficult to stay abreast of current knowledge even in our special fields. Attending the ASM Metal Shows is a most pleasant and effective means of exposing ourselves to the latest technical thought and developments."

C. K. Donoho,
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AMERICAN CAST IRON PIPE COMPANY

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Dr. Ralph W. E. Leiter,
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Show Hours: Monday, Noon - 6 p.m.; Tuesday, Noon - 10 p.m.; Wednesday, Noon - 10 p.m.; Thursday, 10 a.m. - 6 p.m.; Friday, 10 a.m. - 6 p.m.